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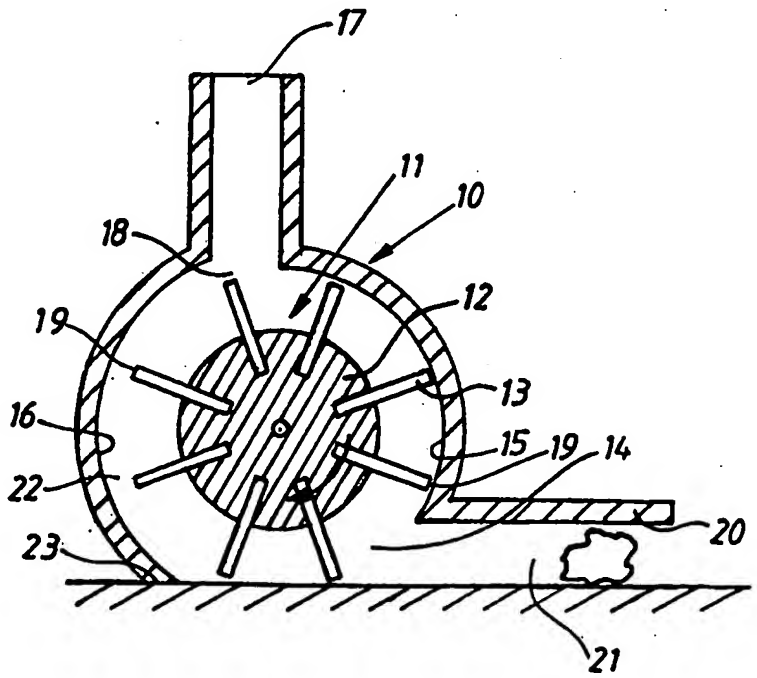
(54) Title: VACUUM CLEANER NOZZLE

(57) Abstract

A vacuum cleaner nozzle having an air inlet opening (14) with associating front and rear inlet parts (15, 16), an air outlet opening (17) communicating with the air inlet opening and an electrically driven roller (11) arranged close to the inlet opening (14). The roller (11) includes several protruding, elongated, strip-shaped elements (13) mainly extending in the length direction of the roller axis. The roller is located in the nozzle such that the tips (19) of the elements, when the roller rotates, are in sealing engagement with one of the inlet parts (15) mainly without deforming the elements (13). The tips (19) are abutting the floor surface during the use of the vacuum cleaner and when the roller is rotated. The tips (19) of the elements are placed at a distance from the other inlet part (16) in order to create an air inlet slot (22).



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VACUUM CLEANER NOZZLE

The present invention relates to a vacuum cleaner nozzle having an air inlet opening with associated front and rear inlet parts, an air outlet opening communicating with the air inlet opening and an electrically driven roller arranged close to the inlet opening, the roller having several protruding elongated strip shaped elements mainly extending in the length direction of the roller axis, the roller being placed in the nozzle such that when the roller rotates the tips of the elements are in sealing engagement with one of the inlet parts mainly without deforming the elements and such that the tips during the use of the vacuum cleaner and when the roller is rotated abuts the floor surface.

Vacuum cleaner nozzles of the brush roller type are previously known and are usually provided with rollers having a cylindrical core with protruding elements beating up the dust from the surface such that the dust can be drawn or suctioned into the inlet opening. These elements comprise elongated strips of brushes or blades of rubber or plastic. The elements are usually spiral wound in the length direction of the roller and are situated at a distance from the associating inlet parts. These nozzles are mostly very efficient but require comparatively large input power which, for ordinary vacuum cleaners connected to mains supply is not any problem but which, when using battery drive, limits the operation time.

It has also been suggested, see US 1915073, to use blades whose free, outwardly extending length is much greater than the distance between the core and one of the inlet parts such that a large area of the blades are in engagement with the inlet part when the brush roller rotates. This nozzle has no electric means for driving the roller. Instead, the incoming air drives the roller together with the blades which serve as sealing elements at one side of the inlet opening.

The arrangement has an extremely low efficiency due to large power losses resulting from the friction between the blades, and the surrounding part of the nozzle.

It is also previously known, see EP-A-388780, to arrange an electrically driven roller, provided with blades, such that the tips of the blades abut the lip-shaped front edge of the inlet opening. However, the blades are spirally-shaped, which means that there is no sealing area between the blades and the front edge. Rather, air can freely flow into the nozzle on each side of the point where the blade touches the front edge.

The present invention is directed toward a brush nozzle which, with limited flow and power losses and without the need to convert the nozzle when moving between soft and hard floors, effectively suctions up dust and dirt from all types of floors. The present invention is also directed toward a nozzle that can preferably be used for battery driven self-operating cleaners, such as robotic vacuum cleaners, in which the available battery capacity is limited.

The present invention is further directed toward a nozzle that makes it possible to suction up large as well as heavy, small particles into the nozzle without lifting the nozzle from the floor surface.

These and further features of the invention will be apparent with reference to the drawing figure, which schematically shows a vertical section through a vacuum cleaner nozzle.

The preferred embodiment of the invention shown in the drawing figure comprises a nozzle housing 10 preferably of plastic and a rotating brush roller 11 having a cylindrical core 12 on which several, mainly axially directed strip-shaped elements 13 such as brush strips or blades of rubber or plastic are arranged. As illustrated, the strip-shaped elements preferably extend along the longitudinal length of the core 12 and radially from the axis of the core 12.

It is also contemplated that elements of different material may be used

on the same core. In case brushes are used the amount of bristles should be chosen so that only a minor air leakage occurs from one side of the element to the other. The housing 10 has an air inlet opening 14 with an associating front inlet part 15 and rear inlet part 16 and an air outlet opening 17. The inlet opening 14 and the outlet opening 17 communicate with one another via an air passage 18. The outlet opening 17 of the nozzle is connected to a vacuum source (not shown) in order to distribute the inflowing particles to a dust container (not shown). The roller 11 is driven by means of an electric motor (not shown) in the nozzle housing.

The front inlet part 15 (as seen in the main direction of movement of the nozzle) has such a shape that the radially outer tip 19 of at least one of the strip shaped elements, when the roller is rotated, is in sealing engagement with the inlet part 15 mainly without deforming the elements thereby preventing air from flowing from the inlet opening 14 to the outlet opening 17 via the inlet part 15. The roller is arranged such that the outer radial tips 19 of the strip shaped elements, when being used on a soft surface, touch the surface. When being used on a hard surface the outer tips of the elements will however be spaced somewhat above the surface and this is achieved by the existence of support means such as rollers or wheels (not shown) which, when the nozzle is used on a soft surface, sink down somewhat into the surface material and, when the nozzle is used on a hard surface, maintain the nozzle and the tips 19 slightly above the surface.

The lower portion of the front inlet part 15 continues into a wall part 20 that is mainly parallel with the surface being cleaned. The wall part 20 is disposed above the surface being cleaned and thereby forms an inlet channel 21 at the front part of the nozzle.

The rear inlet part 16 is placed at a distance from the radially outer tips 19 of the elements thereby forming a slot 22 between the tips and the rear inlet

part 16 through which the air together with the dirt particles flow into the air passage 18. The lower part of the rear inlet part 16 is shaped as a sealing 23 abutting the surface when being used on a soft surface. The lower part of the rear inlet part 16 is placed somewhat above the surface when being used on a hard surface, as noted hereinbefore.

The nozzle according to the present invention operates in the following manner. When the brush roller 11 is rotated in the direction shown by the arrow and with the vacuum source activated air, together with dust, which is whirled up, will be drawn or suctioned into the air passage 18 via the slot 22. Since the tips 19 of the strip-shaped elements 13 engage the front inlet part 15, almost no air will flow into the air passage 18 at this part. Also, since the tips 19 of the elements during rotation of the roller shortly seal against the floor surface there will be a pulsating air flow which contributes to removing particles from the floor and increasing the dust pick-up efficiency of the nozzle.

It should be mentioned that the wall part 20 and the core 12 of the roller, because of their position at a distance from the surface, admit larger particles to be taken up by the nozzle and to be brought up to the air passage 18 without lifting the nozzle. Since the nozzle also creates a high velocity air flow through the slot 22, small, heavy particles which are present on the surface will be taken up by the air flow and transferred to the air passage 18.

In order to decrease the noise level it might be necessary to use elements which are somewhat spirally wound, for instance 5°-30°. However, the pitch of such spirally-wound elements should not be so large as to prevent the desired sealing between the radially outer tips 19 of the elements and the front inlet part 15.

The number of elements 13 may be varied between 2-10 in order to obtain the desired driving characteristics. When few elements are being used these elements will, during each number of revolutions, seal against the surface

a relatively shorter period of the total rotation time. This means a comparatively slow pulsating flow of the type mentioned above. The use of more elements gives, at the same rotational speed, a more rapid pulsation which, to a certain extent, increases the performance of the nozzle.

It is also possible to change the characteristics of the nozzle by changing the size of the slot 22. In order to take up small, heavy particles it is desirable to use high air velocity and small quantities of air and suitable conditions are achieved by adjusting the size of the slot 22. The space between the core 12 of the roller and the surface as well as between the wall part 20 and the surface should be large enough so that large particles, 8-10 mm, can pass up into the air passage 18. It is also possible to use resonance in the vacuum system in order to increase the dust pick up efficiency by adjusting the pulsation frequency to the lengths and volumes of the air channels being connected to the nozzle.

While the preferred embodiment of the present invention is shown and described herein, it is to be understood that the same is not so limited but shall cover and include any and all modifications thereof which fall within the purview of the invention.

CLAIMS

1. Vacuum cleaner nozzle comprising an air inlet opening (14) with associated front and rear inlet parts (15,16), an air outlet opening (17) communicating with said air inlet opening and a driven roller (11) arranged close to said inlet opening (14), the roller (11) defining an axis and comprising several protruding elongated strip-shaped elements (13), said elements extending mainly along the roller axis, the roller being disposed in the nozzle such that tips (19) of said elements, when the roller rotates, are in sealing engagement with one of the inlet parts (15) mainly without deforming the elements (13) and such that said tips (19), during the use of the vacuum cleaner and, when the roller is rotated, abut the floor surface, **characterized in** that the tips (19) of the elements are spaced from the other inlet part (16) to define an air inlet slot (22) therebetween.

2. Nozzle according to claim 1, **characterized in** that the roller (11) comprises a mainly cylindrical core (12) from which the elements (13) protrude, said elements extending radially outward and are slightly spirally shaped as seen in the length direction of the roller.

3. Nozzle according to claim 1or 2, **characterized in** that the sealing engagement is arranged at the front inlet part (15) and the air inlet slot (22) is arranged at the rear inlet part.

4. Nozzle according to any of the preceding claims, **characterized in** that a distance between a lower portion of the front inlet part (15) and the surface is larger than a distance between a lower part of the rear inlet part (16) and the surface.

5. Noxxle according to any of the preceding claims, **characterized in** that at least one of the inlet parts (15,16) is shaped as a part of a cylinder.

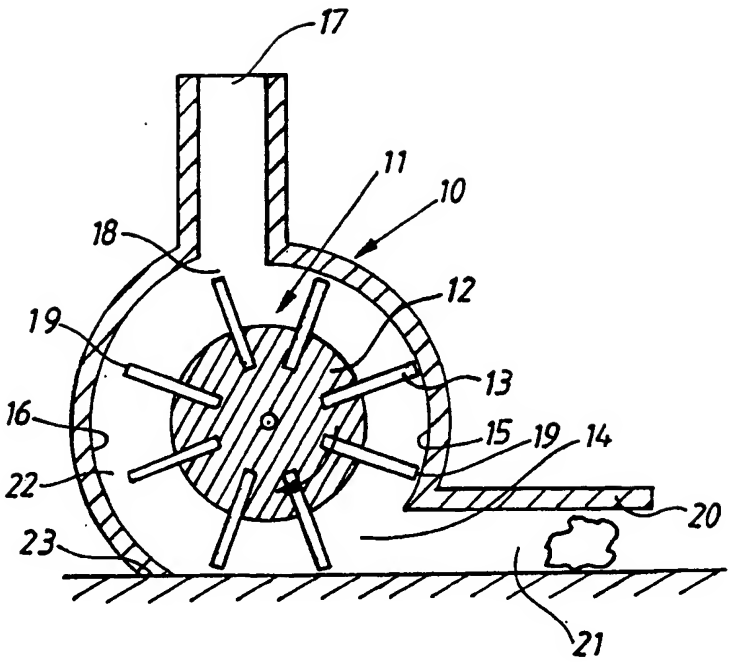
6. Nozzle according to any of the preceding claims, **characterized in** that the front inlet part (15) continues into a wall part (20) which is mainly parallel

to the surface and which is spaced a distance from the surface and directed forwardly as seen in a direction of movement of the nozzle.

7. Nozzle according to claim 6, **characterized in** that a lower portion of the rear inlet part (16) engages the surface when the nozzle is used on a soft surface.

8. Nozzle according to any of the preceding claims, **characterized in** that the roller has at least two strip-shaped elements (13), said at least two elements being made of rubber, plastic or brushes.

9. Nozzle according to any of the preceding claims, **characterized in** that said elements are made of at least two different materials.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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00166

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A47L 9/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0338780 A2 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.), 25 October 1989 (25.10.89), figure 3 --	1-5,8,9
Y	SE 98766 C (O.V. BENGTSSON), 30 April 1940 (30.04.40), figure 1 --	1-5,8,9
Y	US 1915073 A (S.G. SVENSSON), 20 June 1933 (20.06.33), figure 2 -- --------	3-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

03/05/99

International application No.
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SE 98766 C	30/04/40	NONE	
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		FR 687394 A	00/00/00